APPENDIX C.

HABITAT PARAMETER MATRICES

APPENDIX TABLE C-1. MATRIX FOR HABITAT PARAMETERS FOR SEVERAL TRIBUTARIES TO KEECHELUS LAKE							
Keechelus Lake watershed	**Tributary**						
Parameter	**Coal Creek**	**Cold Creek**	**Gold Creek**	**Meadow Creek**	**Roaring Creek**	**Mill Creek**	**Total**
Overall stream length (with tributaries) [miles]	2.95 (3.0)	2.2 (2.6)	5.8 (7.1)	4.2 (4.8)	2.0 (4.1)	2	
1) Blockages, dams, culverts 2) waterfalls	2 culvert barriers under I-90	1913 culvert w/ 8-ft drop at RR, ≈0.25 mi. definite barrier	Falls at about RM 7.1	1) culverts at road crossing are barriers; 2) falls in Reach 2, ≈4 mi. upstream		Blocked by large culvert	
Stream length potentially accessible to migratory fish	2.5	0	7	3.9		0.2	13.6
Watershed area [sq. mi.]	7.1	12.4	35.5	16.5	5.6	2.1	
Mean annual streamflow on a daily basis [cfs]	33.07	23.32	66.21	42.01			
Mean monthly streamflow on a daily basis [cfs]							
Average monthly water temperature		57 °F, 15Jun-11Sep92		58.37 °F, 21Jul-27Sep99; 57.37 °F (7-day max; high temps)			
Max. elevation [feet]	3666	3121	3929	3361	3112	3413	
Min. elevation [feet]	2657.1	2499	2534.5	2678.1	2677	2905	
Max. elevation in watershed [feet]	4511	4263	5350	3937	3321	3914	
Max. slope [feet]	16.5	9.9	16.3	11.6	13.1	15.1	
Min. slope [feet]	2.3	0.4	0.8	3.4	3.3	4.6	
Mean gradient				1=3% 2=3% 3=3%			
Reaches		3 surveyed		1=B3 2=B1 3=B4			
Gradient by reach							
Substrate composition							
• Fines/sediment							
• Sand				8 %			
• Gravel				29%			
• Cobble				32%			

Keechelus Lake watershed	**Tributary**						
Parameter	**Coal Creek**	**Cold Creek**	**Gold Creek**	**Meadow Creek**	**Roaring Creek**	**Mill Creek**	**Total**
• Boulder				17%			
• Bedrock				14%			
Extent of pools, riffles, glides				Good pool presence			
Percent cover in pools							
Length, width, depth, area, substrate measurements in the discrete habitat units (pools, riffles, glides) downstream from barriers	Habitat conds poor, stream has been straightened and channelized along I-90						
Large woody debris		Good WD presence	Little or no key-piece size LWD in channel; no opportunity for recruitment of new key-pieces	Good LWD			
Estimated quantity of spawning and rearing habitat							
Does stream go subsurface at any time during the year, if so, where? Impediment to fish production?		Yes, below culvert, before Lake Keechelus					
Current operations • Flip-Flop • Impacts on adult or juvenile salmonids							
Land ownership in basin							
Land use in the subbasin							
• Livestock grazing				No allotments			
• Timber harvest				Clearcuts w/ some buffer strips			
• Irrigated agriculture							
• Non-irrigated agriculture							
• Mining activity							
• Roads, proximity and density		USFS roads and trail	High risk of road related sediment problems	Heavily roaded, entire stream accessible			

Keechelus Lake watershed	Tributary						
Parameter	**Coal Creek**	**Cold Creek**	**Gold Creek**	**Meadow Creek**	**Roaring Creek**	**Mill Creek**	**Total**
• Recreation, vacation development				Dispersed camping			
• Other anthropogenic activity				Power line			
Biological information							
• Macroinvertebrate surveys				Stoneflies Mayflies Caddisflies			
• Salmonids present			Historically supported anadromous salmonids and bull trout	1 cutt in #1 some YOY salmonids			
• Forage fish species composition and abundance							
• Primary production							
• Riparian conditions		Good riparian shade, riparian area generally intact		Little overstory, loss of riparian shade due to heavy logging			
Cultural and archeological information							
• Old camps, middens, fish bones							

Note
Roaring Creek, Resort Creek and Rocky Run were considered to be too small and steep to support anadromous salmonids.

References and data/information sources:

- Limnological information from Hiebert (USBR, TSC, Denver, CO, 2002, pers. comm.)
- Cold Creek Stream Survey Report, 1992, USFS, Wenatchee National Forest, Cle Elum Ranger District.
- Meadow Creek Stream Survey Report, 1995, USFS, Wenatchee National Forest, Cle Elum Ranger District.
- Rocky Run Creek Stream Survey Report, 1995, USFS, Wenatchee National Forest, Cle Elum Ranger District.
- Haring, D. 2001. *Habitat Limiting Factors, Yakima River Watershed, Water Resource Inventory Areas 37-30, Final Report.* December 2001. Donald Haring, editor. Published by Washington State Conservation Commission. 328 p. plus appendices.

APPENDIX TABLE C-2. MATRIX FOR HABITAT PARAMETERS FOR SEVERAL TRIBUTARIES TO KACHESS LAKE						
Kachess River watershed	**Tributary**					
Parameter	**Kachess River**	**Box Canyon Creek**	**Mineral Creek**	**Gale Creek**	**Thetis Creek**	**Total**
Stream length [miles]	5.5	6.1	19	7	2.7	
Blockages, waterfalls, dams, culverts	Barrier 0.5 mi upstream from Lake Kachess	Barrier falls at RM 1.6	Blockage at 0.25 mi.	Culvert barrier		
Stream length potentially accessible to migratory fish	0.5	1.6	0.25			2.35
Watershed area (with tributaries) [sq. mi.]	13.9 (19.4)	18.0 (21.8)		6	2.1	
Mean annual streamflow on a daily basis [cfs]						
Mean monthly streamflow on a daily basis [cfs]						
Average monthly water temperature		Summer temps 57-68 °F, (1990-94)				
Max. elevation (with tributaries) [feet]	2796	3431 (3475)		4034	3240	
Min. elevation (with tributaries) [feet]	2264	2457 (2457)		2735	2510	
Max. elevation in watershed (with tributaries) [feet]	4223	4966 (4966)		4596	4147	
Max. slope (with tributaries) [feet]	11.6 (15.5)	22.1 (22.1)		16.9	15.1	
Min. slope (with tributaries) [feet]	0.4	3.2 (5.5)		3.3	4.1	
Mean gradient						
Reaches						
Gradient by reach						
Substrate composition						
• Fines/sediment						
• Sand						
• Gravel						
• Cobble						
• Boulder						
• Bedrock						
Extent of pools, riffles, glides		Low # of pools				
Percent cover in pools						
Length, width, depth, area, substrate measurements in the discrete habitat units (pools, riffles, glides) downstream from barriers						

Kachess River watershed	Tributary					
Parameter	**Kachess River**	**Box Canyon Creek**	**Mineral Creek**	**Gale Creek**	**Thetis Creek**	**Total**
Large woody debris	Low in LWD	LWD below Forest Plan standard		Low in LWD	Low in LWD	
Estimated quantity of spawning and rearing habitat		Poor spawning habitat; better summer and winter rearing habitat	Poor spawning and summer and winter rearing habitat			
Does stream go subsurface at any time during the year, if so, where? Impediment to fish production?						
Current operations • Flip-flop • Impacts on adult or juvenile salmonids						
Land ownership in basin						
Land use in the subbasin						
• Livestock grazing						
• Timber harvest		Yes-reduced canopy cover				
• Irrigated agriculture						
• Non-irrigated agriculture						
• Mining activity						
• Roads, proximity and density						
• Recreation, vacation development		Impacts riparian veg				
• Other anthropogenic activity						
Biological information						
• Macroinvertebrate surveys						
• Salmonids present						
• Forage fish species composition and abundance						
• Primary production						
• Riparian conditions		Impacted				
Cultural and archeological information						
• Old camps, middens, fish bones						
Limnological information from Hiebert (USBR, Denver, CO, 2002, pers. comm.)						

APPENDIX TABLE C-3. MATRIX FOR HABITAT PARAMETERS FOR SEVERAL TRIBUTARIES TO CLE ELUM LAKE										
Cle Elum watershed	**Tributary**									
Parameter	**Cle Elum River**	**French Cabin Creek**	**Thorp Creek**	**Cooper River**	**Waptus River**	**Paris Creek**	**Big Boulder Creek**	**Camp Creek**	**Fortune Creek**	**Total**
Stream length [miles]	18.4 (21.0 sc)	3.7	3.8 (5.3 FS)	6.8 (14.1 sc)	9.6 (13.2sc) (10.4 FS)	1.4	2.5	0.8	4.5 (sc)	51.0 ?
Blockages, waterfalls, dams, culverts	Cle Elum Falls ≈ RM9 between Camp and Fortune Creeks		1) 23 falls 2) 5 falls 3) 7 falls	Impassable falls at RM 0.6	Waptus Falls at 7.2 impassable				2) steep w/ many falls	
Stream potentially accessible to migratory fish [miles (km)]	9 (21.6)		0	0.6 (1 km)	7.2, but poor quality			0	0 (above barrier in Cle Elum River)	16.8 (29.4)
Watershed area [sq.mi.]	1,030.8 (1,489.7)	10.6 (12.0)	6.5	112.7	54	2.8	4.3	1.7		
Mean annual streamflow on a daily basis [cfs]										
Mean monthly streamflow in cfs on a daily basis										
Average monthly water temperature			49-64 °F 23 Jun-09 Jul 92							
Max. elevation (with tributaries) [feet]	4222 (5643)	3593 (3593)	3796	2808	4000	3531	4787	3593		
Min. elevation (with tributaries) [feet]	2233 (2233)	2936 (2936)	3143	2338	2578	2846	3788	3268		
Max. elevation in watershed (with tributaries) [feet]	4494 (6491)	4572 (4572)	4723	4487	5430	4812	5705	5175		
Max. slope (with tributaries) [feet]	19.1 (32.1)	10.2 (11.5)	20.5	15.8	18.6	22.8	19	14.5		
Min. slope (with tributaries) [feet]	0.7 (0.7)	5.0 (5.0)	7.2	0.7	1.7	10.3	9.9	8.2		
Mean gradient										
Reaches			1=2.8 mi 2=1.8 mi 3=0.25 mi		1=7.2 mi 2=1.2 mi			1=0.6 mi	1=2.4 mi 2=0.48 mi	
Gradient by reach			1=10% 2=12% 3=>30%		1=3.6% 2=3.8%			36% at mouth	2=14%	

Cle Elum watershed	**Tributary**									
Parameter	**Cle Elum River**	**French Cabin Creek**	**Thorp Creek**	**Cooper River**	**Waptus River**	**Paris Creek**	**Big Boulder Creek**	**Camp Creek**	**Fortune Creek**	**Total**
Substrate composition			1=bedrock /cobble 2=cobble/ cobble 3=gravel/ gravel		1=bedrock /cobble 2=cobble/ gravel			cobble/ gravel/ small boulders		
• Fines/sediment										
• Sand										
• Gravel										
• Cobble										
• Boulder										
• Bedrock										
Extent of pools, riffles, glides			1=39% P 2=37% P 3=24% P FPS?-NO							
Percent cover in pools										
Length, width, depth, area, substrate measurements in the discrete habitat units (pools, riffles, glides) downstream from barriers										
Large woody debris (large/small)			1) 97/74 2) 126/78 3) 11/6		Could be improved					
Estimated quantity of spawning and rearing habitat			Not used by anadro-mous salmonids		Poor spawning potential from mouth to Waptus Falls					
Does stream go subsurface at any time during the year, if so, where? Impediment to fish production?										
Current operations • Flip-Flop • Impacts on adult or juvenile salmonids										
Land ownership in basin			1/3 private		USFS, mostly wilderness			private; USFS		
Land use in the subbasin										
• Livestock grazing										

Cle Elum watershed	**Tributary**									
Parameter	**Cle Elum River**	**French Cabin Creek**	**Thorp Creek**	**Cooper River**	**Waptus River**	**Paris Creek**	**Big Boulder Creek**	**Camp Creek**	**Fortune Creek**	**Total**
• Timber harvest			Clearcut to riparian R2 andR3							
• Irrigated agriculture										
• Non-irrigated agriculture										
• Mining activity										
• Roads, proximity and density	4.48 mi/mi^2		R1-FS Road 4309							
• Recreation, vacation development					FS Trail 1310			campin g		
• Other anthropogenic activity										
Biological information										
• Macroinvertebrate surveys										
• Salmonids present			BRK, CTT							
• Forage fish species composition and abundance										
• Primary production										
• Riparian conditions			Fair		20% shading			Genera lly good		
Cultural and archeological information										
• Old camps, middens, fish bones										
General comments					River generally healthy					

- Limnological information from Hiebert (USBR, TSC, Denver, CO, 2002, pers. comm.)
- SC = Steve Croci;
- FS = Forest Service;

Cle Elum River includes the following tributaries

- Cooper Creek
- Waptus Creek
- Thorp Creek
- Salmon la Sac Creek
- Little Salmon La Sac Creek
- Paris Creek
- Big Boulder Creek
- Camp Creek
- Scatter Creek
- Unnamed Creek

APPENDIX TABLE C-4. MATRIX FOR HABITAT PARAMETERS FOR SEVERAL TRIBUTARIES TO BUMPING LAKE				
Bumping Lake watershed	**Tributary**			
Parameter	**Bumping River**	**Deep Creek**	**Copper Creek**	**Total**
Stream length [miles (km)]	8.2 (14.8)	8.5 (12.8)		
Blockages, waterfalls, dams, culverts				
Stream length potentially accessible to migratory fish	1 (1.6)	5 (8)		
Watershed area (with tributaries) [sq. mi.]	70.0 (87.0)	54.4 (65.8)		
Mean annual streamflow on a daily basis [cfs]				
Mean monthly streamflow on a daily basis [cfs]				
Average monthly water temperature				
Max. elevation (with tributaries) [feet]	4884 (5015)	5020 (5020)		
Min. elevation (with tributaries) [feet]	3483 (3483)	3486 (3486)		
Max. elevation in watershed (with tributaries) [feet]	5221 (5411)	5333 (5705)		
Max. slope (with tributaries) [feet]	9.9 (14.4)	26.9 (26.9)		
Min. slope (with tributaries) [feet]	0.5 (0.5)	1.5 (1.5)		
Mean gradient				
Reaches				
Gradient by reach				
Substrate composition				
• Fines/sediment				
• Sand				
• Gravel				
• Cobble				
• Boulder				
• Bedrock				
Extent of pools, riffles, glides				
Percent cover in pools				
Length, width, depth, area, substrate measurements in the discrete habitat units (pools, riffles, glides) downstream from barriers				
Large woody debris				
Estimated quantity of spawning and rearing habitat				
Does stream go subsurface at any time during the year, if so, where? Impediment to fish production?		Lower 0.5 miles goes subsurface in low water years		
Current operations • Flip-flop • Impacts on adult or juvenile salmonids				
Land ownership in basin	All USFS			

Bumping Lake watershed	Tributary			
Parameter	**Bumping River**	**Deep Creek**	**Copper Creek**	**Total**
Land use in the subbasin				
• Livestock grazing				
• Timber harvest				
• Irrigated agriculture				
• Non-irrigated agriculture				
• Mining activity				
• Roads, proximity and density				
• Recreation, vacation development				
• Other anthropogenic activity				
Biological information				
• Macroinvertebrate surveys				
• Salmonids present		bull trout		
• Forage fish species composition and abundance				
• Primary production				
• Riparian conditions				
Cultural and archeological information				
• Old camps, middens, fish bones				
Limnological information from Hiebert (USBR, Denver, CO, 2002, pers. comm.)				

APPENDIX TABLE C-5. MATRIX FOR HABITAT PARAMETERS FOR SEVERAL TRIBUTARIES TO RIMROCK LAKE									
Rimrock Lake watershed	**Tributary [miles (km)]**								
Parameter	**South Fork Tieton River**	**Short And Dirty Creek**	**Corral Creek**	**Bear Creek (SF Tieton)**	**Bear Creek (Rimrock)**	**North Fork Tieton River**	**Clear Creek**	**Indian Creek**	**Total**
Stream length [miles	17.5		2.5		1.9	12	4.2	8.2	
Blockages, waterfalls, dams, culverts	Falls at RM13.5 barrier to bull trout. Culverts on tribs		falls at RM 2.2; culverts on FS roads 1000 and 1040		Culvert at 3.7 mi.; 7 culvert, 3 possible fish barriers	Falls at RM 9.9		Falls at RM 4.9 barrier to fish	
Stream length potentially accessible to migratory fish	≈ 13.5 mi.	0.1	2.2	3.7	0.5	9.9	2	4.9	36.8
Watershed area [sq. mi.]	73.6		2.4	6.4	6.2	49.3		19.7	
Mean annual streamflow on a daily basis [cfs]									
Mean monthly streamflow on a daily basis [cfs]									
Average monthly water temperature	43-55°F min-max for 6 months. Meets FPS		45-61°F 7Jul -25 Sep 1998		Meets FPS	46-56°F 7Jul - 25 Sep 1998	45-48°F Aug 1997	45-56°F 12-30 Aug 99	
Max. elevation (with tributaries) [feet]	4507 (5942)			4964	3077	5426 (5426)		4993 (4993)	
Min. elevation (with tributaries) [feet]	2950 (2950)			4343	2981	2943 (2943)		3131 (3131)	
Max. elevation in watershed (with tributaries) [feet]	5604 (6816)			6175	3932	6745 (6745)		5289 (5289)	
Max. slope (with tributaries) [feet]	18.4 (29.4)			19.6	10.9	23.5 (34.3)		16.9 (33.0)	
Min. slope (with tributaries) [feet]	1.7 (1.7)			8.3	2.0	0.8		2.0	
Mean gradient					3%	1) <1% 2) 2.1% 3) 0.01-3.5+%	1=3% 2=3%		
Reaches	7					1) 3.65 mi. 2) 2.9 mi. 3) 3.4 mi.		1=3.5 mi.	
Gradient by reach	1=1% 2=1% 3=2-3%		17% 2-5% near mouth					1=<3%	

Rimrock Lake watershed	**Tributary [miles (km)]**								
Parameter	**South Fork Tieton River**	**Short And Dirty Creek**	**Corral Creek**	**Bear Creek (SF Tieton)**	**Bear Creek (Rimrock)**	**North Fork Tieton River**	**Clear Creek**	**Indian Creek**	**Total**
Substrate composition									
• Fines/sediment					High sedimentation				
• Sand						1) 46% in pools; does not meet FPS 2) 27.5 % in pools; 3) 45.3 % in pools	2) sand, gravel	1) 16.7% in pools; meets FPS	
• Gravel							1) gravel, sand		
• Cobble									
• Boulder									
• Bedrock									
Extent of pools, riffles, glides	Pools 0.08-0.43 (<FPS)				Pool freq does not meet FPS			Pool freq does not meet FPS	
Percent cover in pools									
Length, width, depth, area, substrate measurements in the discrete habitat units (pools, riffles, glides) downstream from barriers						1) 51.9% P 2) 40.8% 3) 43.4%	1)28% P 2) 41%	1) 4.57% Pools	
Large woody debris	1=<FPS 2=meets FPS 3=<FPS				Meets FPS	1, 2, 3 meet FPS	1, 2 meet FPS	1 does not meet FPS	
Estimated quantity of spawning and rearing habitat	Good spawning; 85 redds in 2000 survey								
Does stream go subsurface at any time during the year, if so, where? Impediment to fish production?							braided channel, some channels go dry		

Rimrock Lake watershed	**Tributary [miles (km)]**								
Parameter	**South Fork Tieton River**	**Short And Dirty Creek**	**Corral Creek**	**Bear Creek (SF Tieton)**	**Bear Creek (Rimrock)**	**North Fork Tieton River**	**Clear Creek**	**Indian Creek**	**Total**
Current operations • Flip-flop • Impacts on adult or juvenile salmonids									
Land ownership in basin	Mostly Fed., some private upstream		USFS						
Land use in the subbasin									
• Livestock grazing	Some impact on riparian		In riparian and adjacent meadows			No allotments		Historically heavily grazed	
• Timber harvest			Some in last 20 yrs		Some	Some in R2; R3=none		Some limited early	
• Irrigated agriculture									
• Non-irrigated agriculture									
• Mining activity			Some in mid 1800s			Prospected in mid 1800s			
• Roads, proximity and density			nearby		Close to stream	FS Road 1207parallels stream		Paralleled by FS Road 1308	
• Recreation, vacation development	ORV use, some fishing, hunting, hiking		ORV, hunting, travel, dispersed camping		Summer homes	Hiking, camping, fishing, trail riding		Campsites, summer homes	
• Other anthropogenic activity									
Biological information									
• Macroinvertebrate surveys									
• Salmonids present	RBT, CTT BRK, bull trout					1=RBT, CTT	BRK		
• Forage fish species composition and abundance	*Cottus* spp.						*Cottus* spp.	*Cottus* spp.	
• Primary production									

Rimrock Lake watershed	**Tributary [miles (km)]**								
Parameter	**South Fork Tieton River**	**Short And Dirty Creek**	**Corral Creek**	**Bear Creek (SF Tieton)**	**Bear Creek (Rimrock)**	**North Fork Tieton River**	**Clear Creek**	**Indian Creek**	**Total**
• Riparian conditions	Poor - livestock grazing				Heavily vegetated - alder				
Cultural and archeological information								Part of Cowlitz Trail	
• Old camps, middens, fish bones									
General comments	R4,5, 6 =good bull trout spawning habitat			Habitat pristine		Partly in Goat Rocks Wilderness		Large no. of spawning bull trout	
Sources	FS Reports					FS 1999	FS 1997	FS 1999	

Limnological information from Hiebert (USBR, TSC, Denver, CO, 2002, pers. comm.)

FPS = Forest Plan Standards
FS = Forest Service

South Fork Tieton River tributaries
- Short and Dirty Creek
- Conrad Creek
- Bear Creek
- Corral Creek
- Tenday Creek